

Biorefineries - A Powerful Tool to Diminish the Human Footprint

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Abstract

On the edge of petroleum exhausting and dependency, solutions are needed. In this short commentary/opinion an overview of the presence of human being in the world have caused, and the solutions that can become a tool to address some of those issues. The biomass concept is discussed and presented as an alternative to producing products to compete with those from fossil sources towards the implementation of biorefineries.

Keywords: Sustainable; Biorefinery; Carbon dioxide; Biomass

The ages, customs, approaches, methodologies, processes, but above all mentalities have changed or are changing, well at least I like to believe so. The crude oil refinery industry and all the products resulting from that plays a central role in our daily lives as we know it, and we must be realistic, in the near future, we will still be depending on that to sustain the commodities and comfort that we are used to and the world that we have created. The problem related to such way of life was already identified a long time ago. Our habits have led to the extinction of plant and animal species. With the new millennium, nine species has already become extinct, during the 20 century 159 living creatures have disappeared and if we extend the period until the last 500 years, almost one species per year have vanished from the face of the Earth [1]. In the upcoming years, this trend will continue to occur unless we change our habits, the way we look not only to our surrounding, but the way we face the world as a whole. However, I believe that we all have the conscience of that reality, at least I do. However, the advances in this direction have not been happening as fast as the technological advances that the human being witnessed in the last few centuries. But don't get me wrong I am completely devoted to technology, in fact, I am one of those who is gadget addicted.

The world dependency of fuel, raw materials, and products is mostly based on a carbon dioxide emission cycle. Now at the edge of fossil source depletion, tremendous carbon dioxide emissions, with so much environmental mistakes to fix, we are forced to solved all those problems at the same time, while striving to maintain everything needed to keep the world progressing as we are used to. Well, some of those problems can, should and certainly will be fixed. While the dependency on oil and the environmental issues may have a solution, the extinct species are forever gone, but we can prevent and preserve those who still share the globe with us. Governments, countries, environmental agencies, scientific committees often arrange treaties, agreements, principles and set objectives but quite rarely they are achieved and the problems continue to exist [2,3].

One of the solutions pointed as the putative alternative to fossil sources are the use of the so acclaimed biomass. Biomass is by definition is the organic matter that overcomes from living sources. Such raw material can be used to produce energy. Although this may seems a fancy a recently introduced concept, it has been out there since caveman ages when they first discovered fire and did the first bonfire in history. Spite the usual relationship to lignocellulosic materials, those directly associated with plants and forestry matter not considered as human foodstuff, this energy source can also result from human, agriculture, industrial wastes [4]. One of the major difficulties of lignocellulosic biomass based energy production is its inconsistency in chemical terms, seasonality, water content, and availability. The major advantage of biomass is that the carbon dioxide and the water vapor released into

the atmosphere is then reabsorbed by the coppices and crops, although that does not occur at the same rate, but still can be considered almost as a neutral carbon dioxide neutral cycle. On the other hand, we have the fossil fuels emitting not only CO₂ but also NO_x, carbon monoxide amongst other harmful compounds. So how to deal with this oxymoron? The world cannot bear such pollution level, but we cannot sustain our way of living without it. A new paradigm has been architected and constructed over the last decades. New concepts have been introduced along with new ideas, solutions, models have arisen, like Short Rotation Coppices, renewable energies (solar, aeolic, wave-based, etc.), but above all these concepts, one has stand-out, the biorefinery framework. The idea as we all know is based on the use of biomass for the production of added-valuable products and is intended to produce energy and goods to substitute those overcoming from fossil reserves. It is clearly the amount of lignocellulosic biomass available to be used as feedstock for such facilities is not sufficient, but what about the other type of wastes? According to United Nations Environment Programme (UNEP), in 2011, 5 billion metric tons of agricultural biomass waste was produced annually, representing *ca.* of a quarter of the equivalent of the energy generated by fossil sources. This type of wastes was mainly composed of residues from crops, leaves, roots, seeds and seed shells, waste wood, wastes from livestock. These type of raw materials must be seriously equated to be used for the production of fuels and chemicals. This abundant feedstock with no cost is usually left on the fields or directly burnt, losing its potential to produce added value products in biorefineries. This source of energy can be the center of closed carbon cycle where there are few harmful emissions and a clean source. Moreover, it can represent an additional income for those who produce it [5]. Biorefineries are believed to be, in the near future, capable of producing fuels, chemicals or products. The processes to be developed embraces biological, chemical or physical approaches. Those processing methods comprises biological (anaerobic and aerobic fermentation), thermo-chemical (pyrolysis, gasification, direct combustion, direct liquefaction) or physical (e.g., briquetting, pelleting) processes. In the last years, millions of dollars have been invested in the construction

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and development of biorefineries around the world. Companies like: Alpena Biorefinery [6] (USA), SECIL [3] (pilot plant, Portugal), Steeper Energy [7] (Denmark), Celtic Renewables Ltd [8] (Scotland), UPM [9] (Finland), Enerkem [10] (Canada), amongst much more companies are betting on this solutions, and pretty soon biorefineries will be part of our daily lives. We as scientists have the responsibility to develop the processes, knowledge, and technologies that will address, if not whole, some of the issues caused by the presence of humans in the small blue point in the universe. So, let's get to work!

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